



U.S. Department of Energy
Energy Efficiency and Renewable Energy

Zero Energy Homes

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DOE's Residential Program

- Building America
 - Reduces whole house loads 60-70%
 - Includes envelope (insulation, windows, doors), appliances, lighting & HVAC
- Zero Energy Homes
 - Provides energy for remaining 30-40%
 - Includes building integrated solar electric & thermal, integration & optimization, peak load shaving, & energy management automation



Zero Energy Building Vision

- America's new homes and commercial buildings will produce as much energy as they use. These buildings will be affordable, durable, healthy, productive and more comfortable. (Adapted from Zero Energy Home Roadmap)
- To qualify as ZEH—must cut utility bill 50% and include renewable energy



Zero Energy Home Progress

- Hundreds of Zero Energy Homes are being built
 - Most in California, Arizona, & Nevada
 - First subdivision of 250 ZEH under construction
 - Limited ZEH in NJ, NY, MD, IL, TX, FL, VA, & MA
- ZEH sells best where it is standard in a new home
 - Economics are best
 - ZEH in 10 to 33% of homes sells fine
 - ZEH as an option now being tested
- ZEH peak communities value to utilities
 - Zero summer peak when needed by utilities
 - ZEH Today--time-of-use rates cut utility bills by 80%



ZEH Homebuilder Teams

- ZEH Teams are designing, building marketable prototypes & subdivisions, & monitoring under DOE's Building America Program
 - Consol (Pardee, Shea, Morrison, Clarum & Premier)
 - Davis Energy Group (Centex)
 - NAHB (John Wesley Miller)
 - Steven Winter Assoc. (W. Mass, Bradley & Claretian)
 - Building Science Corporation (Bentwood Homes)
 - IBACOS, Inc



Zero Energy Home Projects

- Completed or under construction
 - Shea Homes, San Diego (120 of 300 homes)
 - Centex Home, Livermore CA (1 ZEH home)
 - John Wesley Miller, Tucson, AZ (99 homes)
 - Pardee Homes, Los Angeles (Optional in 4 subiv.)
 - Clarum Homes, East Palo Alto (20 Homes)
 - Morrison Homes, Sacramento (10-15 homes)
 - Clarum Homes, Watsonville, CA (250 Homes)
 - Bradley Homes, Long Island, NY (1 Home)
 - Pardee Homes, Los Vegas (Optional in 2 subdiv.)
 - Claretian Associates, Chicago, (3 homes)
 - Centex Homes, San Ramon, CA (2 models & optional)
 - Premier Homes, Sacramento (95 homes)
 - Western Massachusetts Electric. Co (1 home)



Shea's High Performance Homes

- 306 homes completed early
- Homes about 40% better than Title 24
- All have Solar Water Heaters
- 120 have 1.2 kw or 2.4 kw of PV (about 25 upgraded)
- Shea Homes appreciated faster than neighboring homes
- More profitable to offer as standard than as option
- Higher price not perceptible to buyer
- If builder includes, buyer accepts
- 2004 survey of Shea & neighboring subdivision (57% return)



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Shea's San Angelo Subdivision





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SunChoice™ Power Meter





Clarum Homes—100% ZEH

- Building only ZEH in the future
- Over 300 homes, townhomes & apartments
- Single family homes
 - 2-3 kw solar electric
 - Spectrally selective windows
 - Tankless water heaters
 - CFL lighting
 - Radiant roof Barrier sheeting
 - Recycled content decking
 - Water conserving landscape
 - Environmentally friendly flooring
- Selling faster than competition



ZEH Market Research (CA)

- 56% believe that everyone should be personally responsible for saving energy
- 59% would spend money to save energy, if they could recover costs in lower energy bills
- 41% think the energy crisis (CA) should have been a wake up call for all to conserve
- 69% do not feel that new homebuilders are paying enough attention to their environmental impact
- Over 2/3 of buyers feel they themselves are only somewhat aware of environmentally friendly building techniques & features (Source: America LIVES, Inc)



ZEH Market Research (CA)

- If you have a product that is both energy efficient AND green, over 2/3 of the market are going to be interested in it. The appeal of a two-pronged attack is much wider.
(Source: America LIVES, Inc)



Centex Second Generation ZEH

- Saves 55% of traditional energy
- Zero electric bill based on time-of-use rates
- Combined (gas & electric) 82% annual utility cost savings
- Positive cash flow for buyer - annual energy savings exceed incremental increase in mortgage payments
- To be featured in Centex Design Center
- Homebuyers will have a number of energy options



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Centex Homes--Windemere Subdivision

PV Modules & Solar Water
Heater





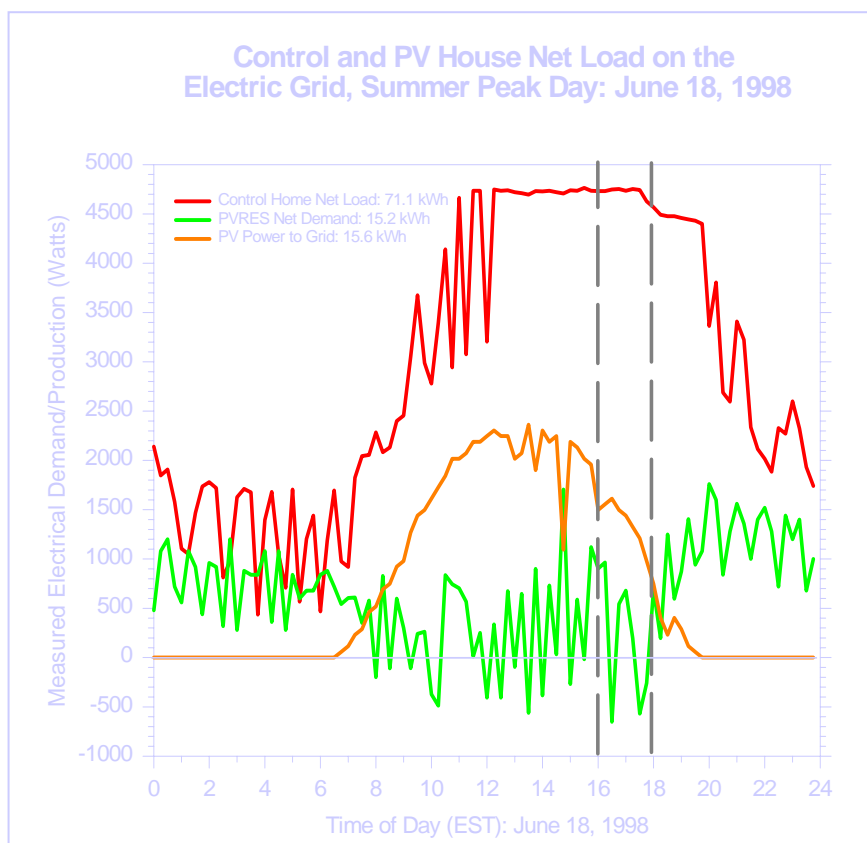
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Western Massachusetts Electric Company





Early Modeling: Improved Grid + Less Energy



Source: Florida Solar Energy Center (FSEC)

- Grid-connected PV system, solar water heating, & energy-efficient equipment.
- 4kW PV supplied most of the home's daytime electrical needs on peak summer days
- Hottest summer day ZEH used:
 - 72% less power to run its AC
 - 93% less utility-supplied power

Energy Savings			
	Power Use (kWh)	Net Power Use (kWh)	Monthly Cost of Power (\$)
Zero Energy Home	837	335	\$27
Control Home	1,839*	1,839*	\$147

*Air-conditioning only

Source: FSEC



Building Integrated Solar R&D

- Space/water heating consumes about 50% of total energy use in today's & future ZEH homes
- Solar thermal can serve about 50% of space & water heating loads
- Conceptual designs looking at both air & water based systems
- Air based system will improve the efficiency of PV
- Must be aesthetically pleasing & cost-effective



Next Steps

- Provide ZEH design assistance to builders
- Design, build & monitor zero peak communities
- Understand ZEH buyer motivations
- Lay groundwork for ZEH time-of-use rates
- Develop automated whole house controller
- Develop building integrated solar electric & thermal roof systems